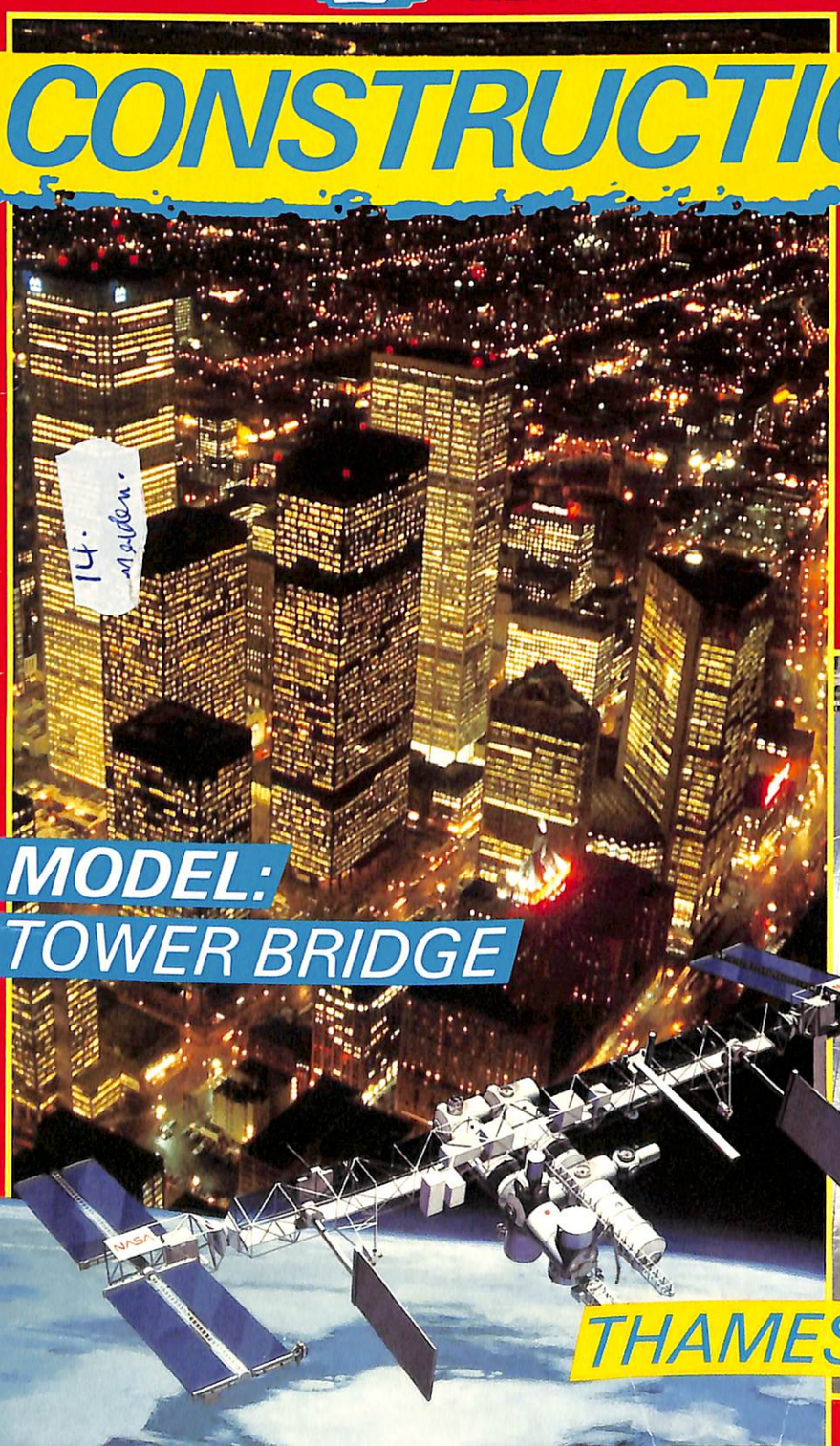
A Marshall Cavendish Collection

EVERY FORTNIGHT

QUEST

ADVENTURES IN THE WORLD OF SCIENCE

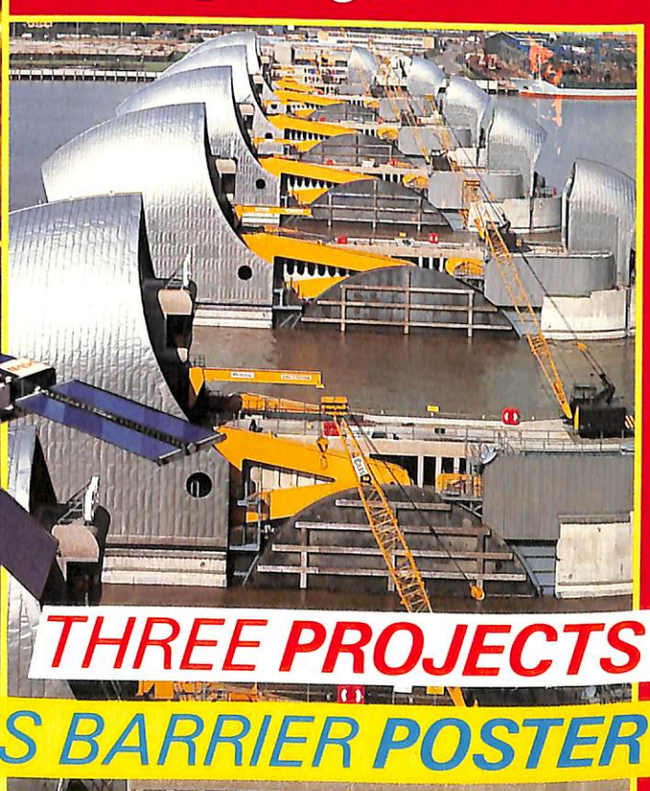
CONSTRUCTIONS 13



MODEL:
TOWER BRIDGE

FACT FILES ON:

- Mega machines
- Dam dynamics
- Water barriers
- Modern materials
- Nature's architects
- Ultra-high skyscrapers
- Swing bridges



THREE PROJECTS

THAMES BARRIER POSTER

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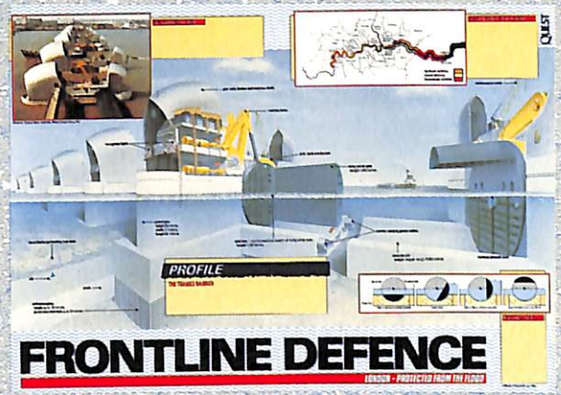
INSIDE THIS PACK

FACT FILES

▶ Diggers and pile drivers ▶ Building in space ▶ Damming up water ▶ Ingenious bridges ▶ Blasting tunnels ▶ Termite mounds and beaver lodges ▶ Counteracting skyscraper sway ▶ Reinforced concrete



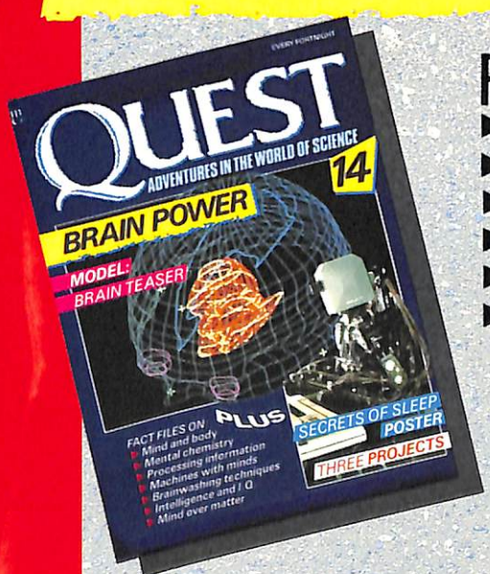
Thames Barrier

MODEL: Tower Bridge

PROJECTS

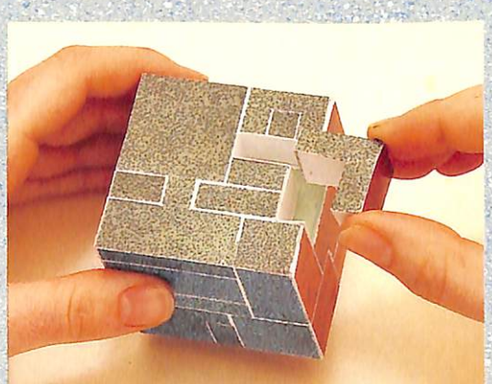
- Make a floor plan
- Check water pressure
- Test structural strength

COMING IN QUEST 14 BRAIN POWER



FACT FILES include:

▶ Mind and body
▶ Importance of brain size
▶ The effect of drugs
▶ Brain disorders
▶ Hypnosis and ESP
▶ Machines with minds?



POSTER:
Sleep and dreams

MODEL:
Brain teaser

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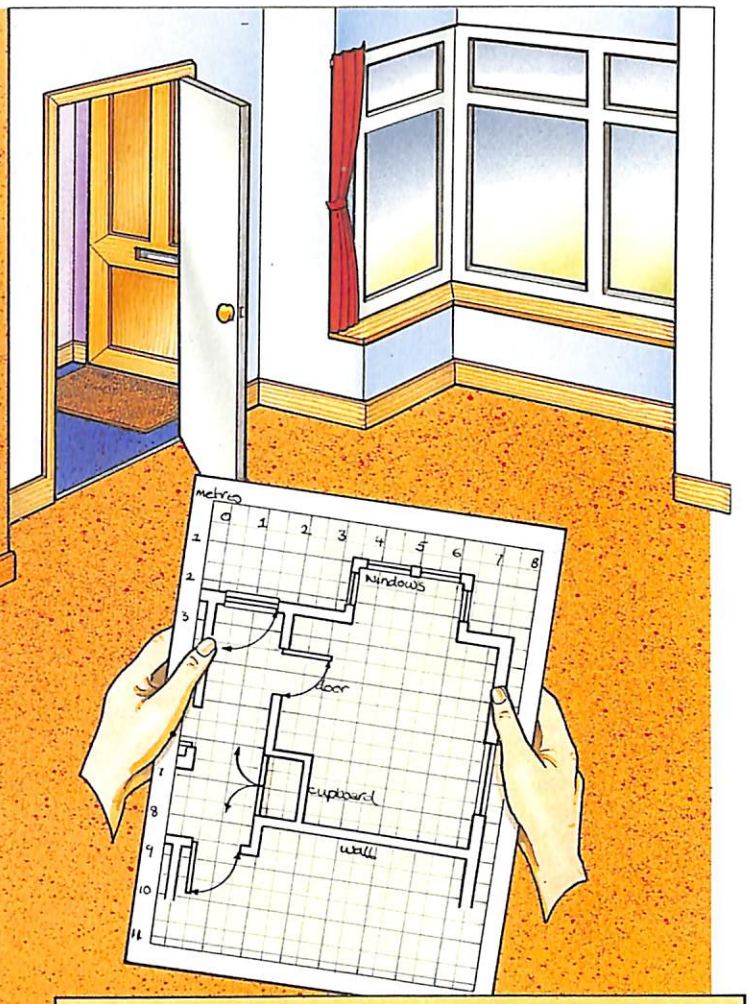
PROJECTS

CONSTRUCTION

- How can you make a plan of your flat or house?
- Why does a dam have to be thicker at the bottom?
- What feature of an egg makes it resist crushing?



ARCHITECTURAL PLAN

1 2 **3** 4 5

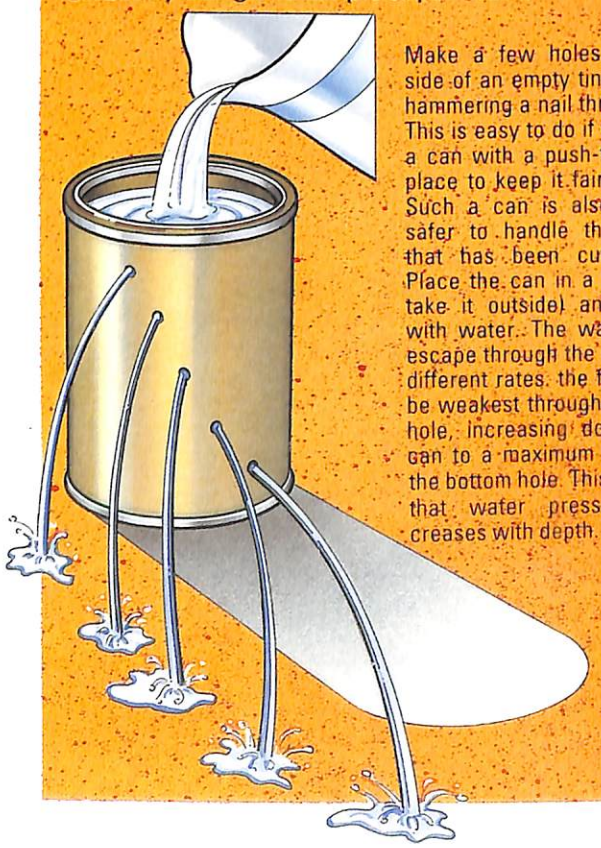
All you need to make a plan of your room is some graph paper, simple drawing instruments and a tape measure.

Make a quick, rough sketch of the area first as this will help you to choose a suitable scale for the final plan. Measure the distances along all the walls and note these lengths on your sketch. Also note the thickness of each wall – if you can't measure or calculate a thickness, you will have to make a guess. Add up the lengths along each side of the plan to find the overall dimensions (in metres), then measure the sides of the graph paper (in centimetres). You will probably be able to fit the plan on the paper if you let one centimetre on it represent one metre along the building. However, if there is sufficient room on the paper, use two or more centimetres to represent one metre, so that you end up with a larger plan. Draw the walls to scale on the graph paper, then add other features such as doors and windows.

DEPTH AND PRESSURE

1 **2** 3 4 5

A dam is thicker at the bottom because water pressure increases with depth. Demonstrate this effect by doing this simple experiment.



Make a few holes in the side of an empty tin can by hammering a nail through it. This is easy to do if you use a can with a push-fit lid in place to keep it fairly rigid. Such a can is also much safer to handle than one that has been cut open. Place the can in a sink (or take it outside) and fill it with water. The water will escape through the holes at different rates: the flow will be weakest through the top hole, increasing down the can to a maximum through the bottom hole. This shows that water pressure increases with depth.

SHAPED FOR STRENGTH

1 2 3 4 5

Although an eggshell is very thin, its domed ends can withstand great external pressures.

Take a chicken's egg, raw and uncracked, and hold it by pressing its ends gently between the palms of your clasped hands, as shown. Try to crush the egg by gradually increasing the pressure you apply. (This is best done over a bowl, just in case you do manage to break the egg.) As your palms press on the egg, they 'give' to match the curved ends. So the applied force is spread over a fairly large area. The curved shape of the egg transmits this inward force sideways through the shell. The combination of these two effects makes it very difficult to crush the egg.

PROJECT INFORMATION

1 2 **3** 4 5

Each **QUEST** project has its own difficulty rating: 1 very simple, 2 simple, 3 intermediate, 4 advanced, 5 complicated.

WARNING!

Parents should supervise experiments involving sharp tools, water and electricity. The publisher can accept no responsibility for injury.

MODEL

TOWER BRIDGE

ASSEMBLY INSTRUCTIONS

You will need

Scissors • Ruler • Craft knife • Glue
2 × 35 mm cocktail sticks
Before cutting out the pieces, score along all broken lines with a blunt edge and ruler to make folding and gluing easier. Study the ASSEMBLY DIAGRAM to see how the pieces fit together, and use dotted lines as a guide for positioning.

NB Make up the tower on card 1 first.

To make up

Bascules and road deck

1 Cut out underside bascule **A**. Cut out squares using a craft knife and fold and glue to shape (see ASSEMBLY DIAGRAM).
2 Cut out bascule top **B** and fold to shape. Glue underside edges of **B** to tabs on **A** to complete bascule and road deck.

Piers

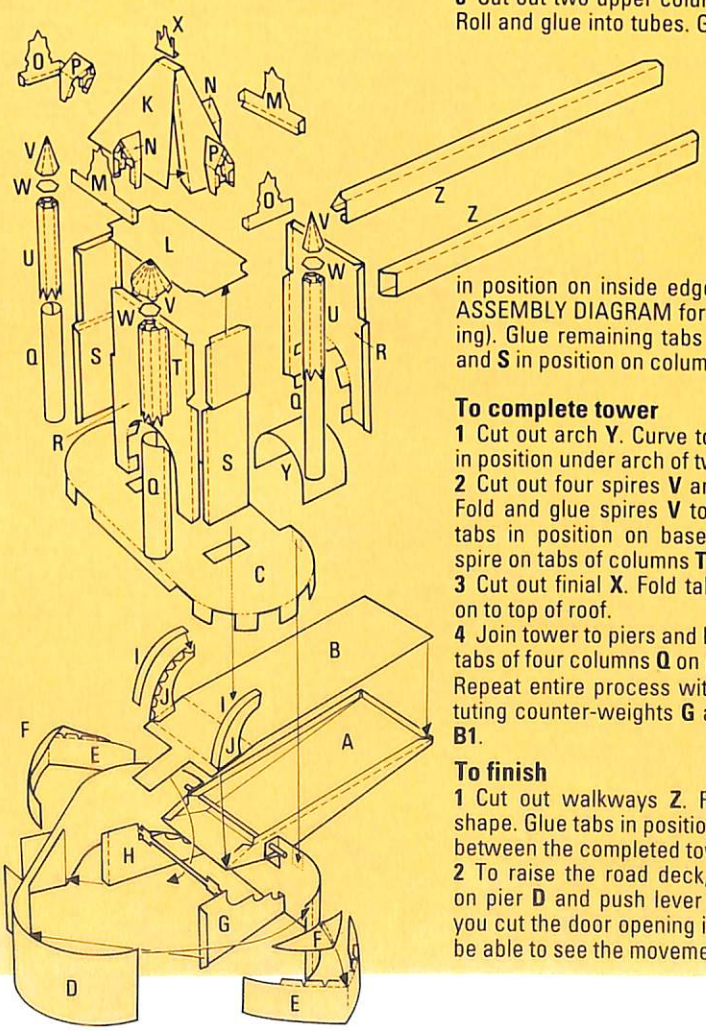
1 Cut out **C**. Cut out rectangles using a craft knife and fold tabs down.
2 Cut out **D**. Cut out squares using a craft knife and fold flaps back. Cut slots where indicated and fold out. Fold **D** to shape, but do not glue at this stage.
3 Glue tabs i and ii of **C** in position on inside edge of pier **D**, to form opening for bascule.
4 Push bascule **A/B** through opening on piers **C/D**. Align the squares, and push a cocktail stick through each thickness. Apply glue at ends to hold sticks in place.

To complete piers and bascule

1 Glue the two ends of **D** together to shape.
2 Cut out counterweight **G** and **H**. Fold to shape and glue arm tab on **H** in position on **G** . Glue **G/H** in position inside pier **D** (see ASSEMBLY DIAGRAM).
3 Complete piers by gluing remaining tabs on **C** to upper inside edge of **D**.
4 Cut out two side sections **E** and two **F**. Fold **E** to shape and fold tabs down. Fold and glue **F** to shape and glue in position on tabs of **E**. Glue **E/F** in position on either side of pier **D** (see ASSEMBLY DIAGRAM).
5 Cut out two pieces **I** and two pieces **J**. Fold tabs on **J** down and glue **I** on to tabs. Glue completed pieces **I/J** in position on either side of bascule **B**, going through rectangles in **C**.

Towers

1 Cut out roof **K**. Fold and glue to shape (see ASSEMBLY DIAGRAM).
2 Cut out one piece roof **L**. Glue tabs of **K** in position on roof **L**.
3 Cut out two windows **M** and two dormers **N**. Fold tabs of **M** down. Fold **N** to shape and glue in position on **M**. Glue tabs of **M/N** in position on roof **L**, and roof **K** (see ASSEMBLY DIAGRAM).
4 Cut out two windows **O** and two dormers **P**. Assemble in the same manner as windows and dormers **M/N** and glue in position on roof **L**, and roof **K**.



5 Cut out two walls **R**. Fold tabs down.
6 Cut out four columns **Q**. Roll and glue into tubes. Glue on lower half of walls **R**.
7 Cut out two walls **S**. Fold to shape and fold tabs down. (Cut door opening where indicated if you wish to see the movement mechanism in operation.) Glue tabs of lower wall **S** in position on four columns **Q**.
8 Cut out two upper columns **T** and two **U**. Roll and glue into tubes. Glue tabs of tubes in position on inside edge of each **Q** (see ASSEMBLY DIAGRAM for correct positioning). Glue remaining tabs of upper walls **R** and **S** in position on columns **T** and **U**.

To complete tower

1 Cut out arch **Y**. Curve to shape and glue in position under arch of two walls **R**.
2 Cut out four spires **V** and four bases **W**. Fold and glue spires **V** to shape and glue tabs in position on bases **W**. Glue each spire on tabs of columns **T** and **U**.
3 Cut out finial **X**. Fold tab down and glue on to top of roof.
4 Join tower to piers and bascule by gluing tabs of four columns **Q** on pier **C**.
Repeat entire process with card 2, substituting counter-weights **G** and **H** for **A1** and **B1**.

To finish

1 Cut out walkways **Z**. Fold and glue to shape. Glue tabs in position on two walls **R**, between the completed towers.
2 To raise the road deck, open the doors on pier **D** and push lever on bascule **B**. If you cut the door opening in wall **S**, you will be able to see the movement inside.

TOWER BRIDGE

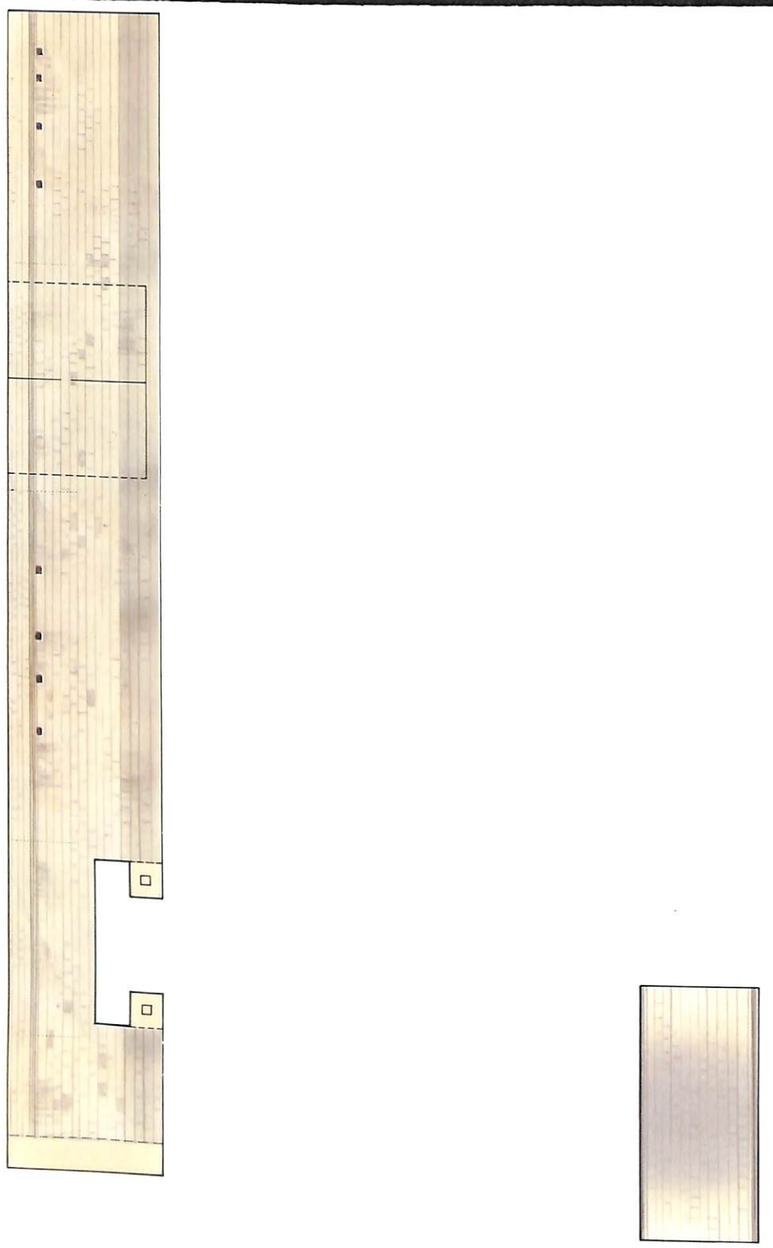
CARD 1

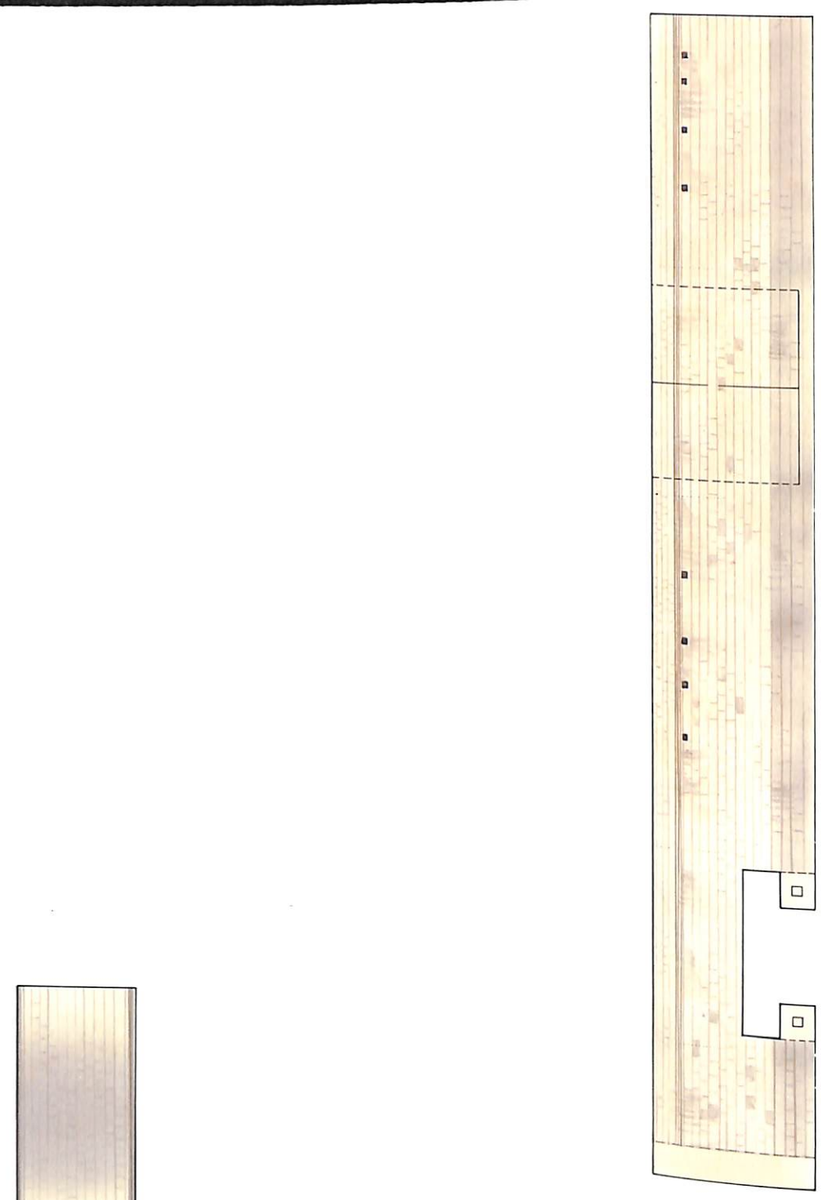
CARD 2

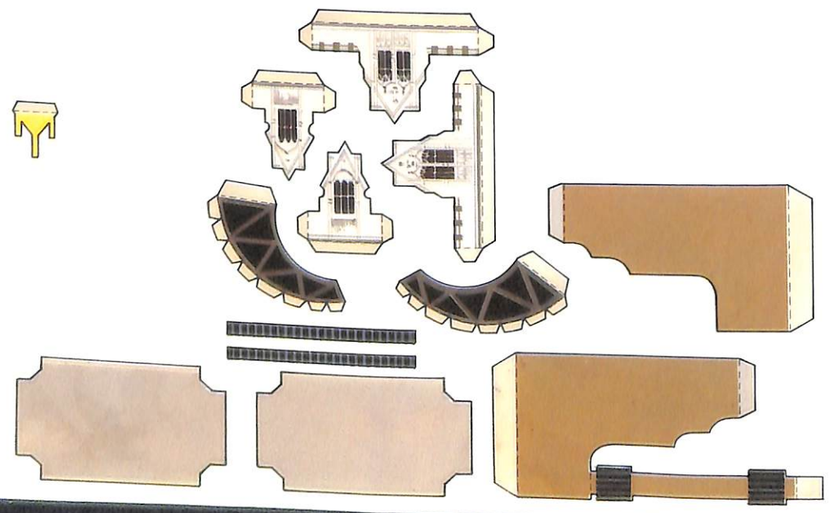
cut out

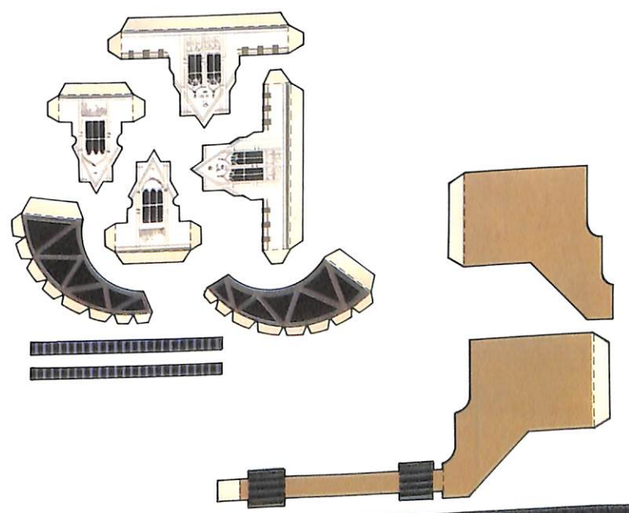
cut slots

cut







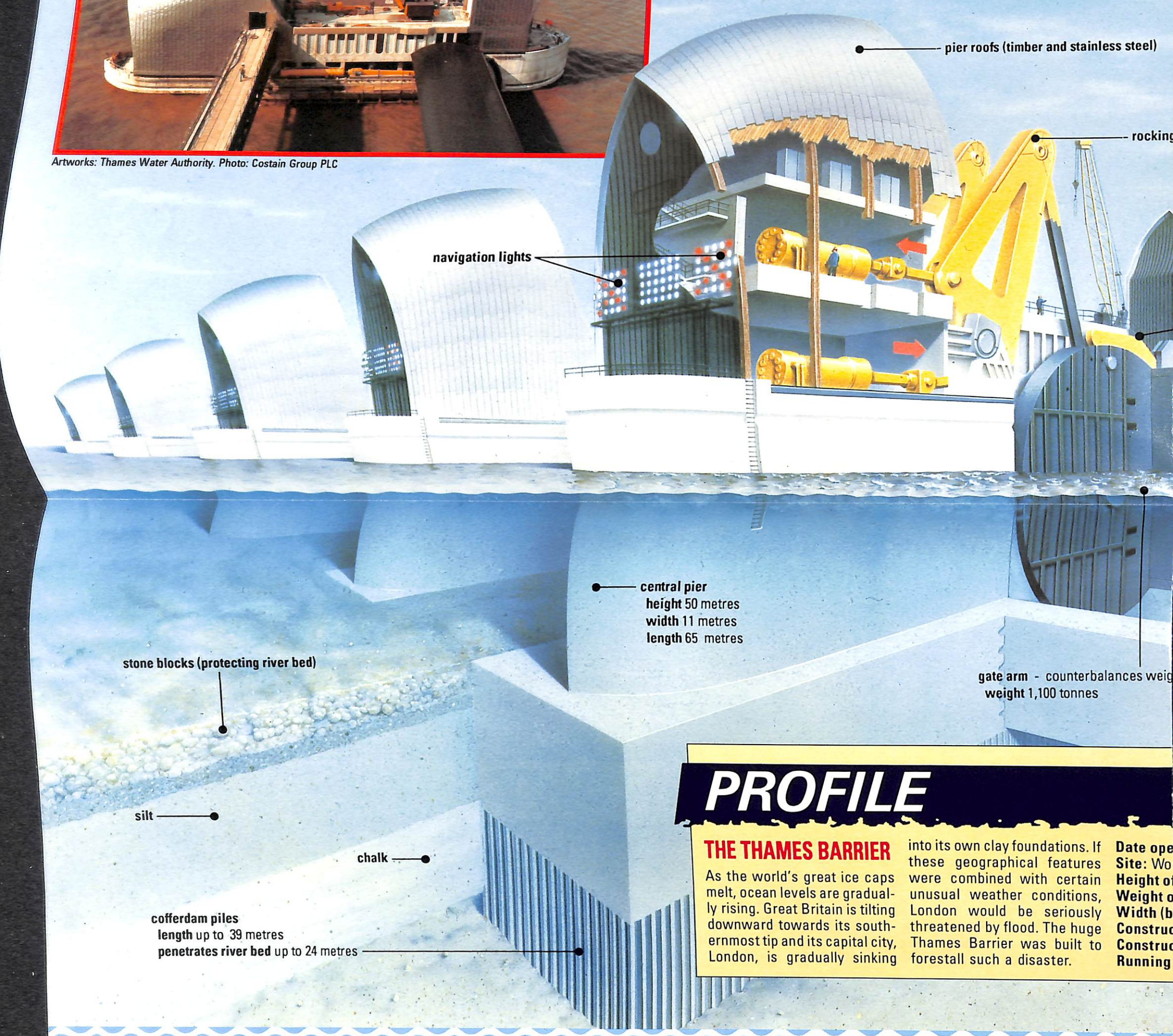


Artworks: Thames Water Authority. Photo: Costain Group PLC

THE BARRIER SYSTEM

The revolutionary Barrier is a series of movable gates. The gates lie in a line across the river, separated by nine concrete piers that house the machinery needed to lift them into defence position.

There are two types of gate – rising sector gates (which rest beneath the water) and falling radial gates (which rest above the water). The four main rising sector gates – each 61 metres across – lie between the five centre piers. These are flanked on either side by two similar (but smaller) gates, each 31.5 metres across.



PROFILE

THE THAMES BARRIER

As the world's great ice caps melt, ocean levels are gradually rising. Great Britain is tilting downward towards its southernmost tip and its capital city, London, is gradually sinking into its own clay foundations. If these geographical features were combined with certain unusual weather conditions, London would be seriously threatened by flood. The huge Thames Barrier was built to forestall such a disaster.

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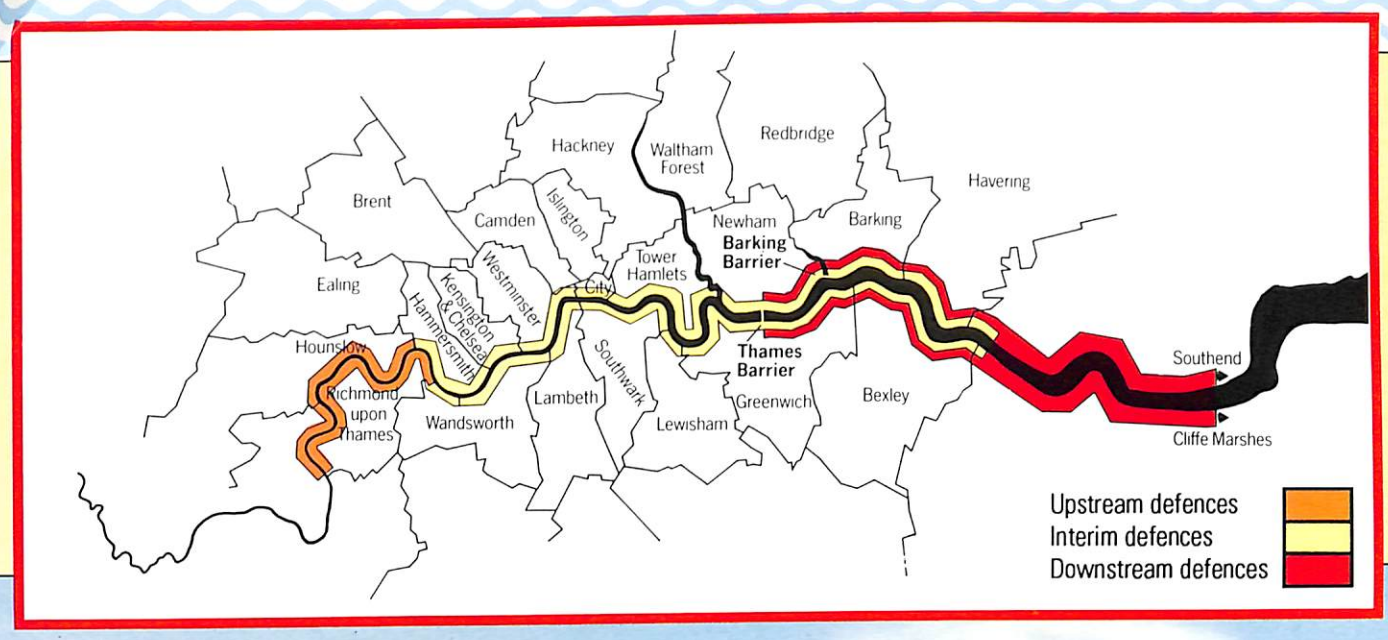
Site: Wo
Height o
Weight o
Width (b
Construc
Construc
Running

FRONTLINE



FLOOD PROTECTION SCHEME

Although a key feature in defending the capital against a flood, the Thames barrier does not provide complete protection. For some 32 km immediately downstream of the barrier, the river banks have been raised by two metres; much further upstream, in the city's suburbs, landscaped riverwalks have been built on reconstructed banks. During construction of main defences 102 km of bank were raised as an interim measure, to be replaced later with permanent floodwalls. Many smaller flood gates have been built along a 50 km stretch.

maintenance crane

beam

shift latch mechanism

rising sector gate
weight 1,500 tonnes

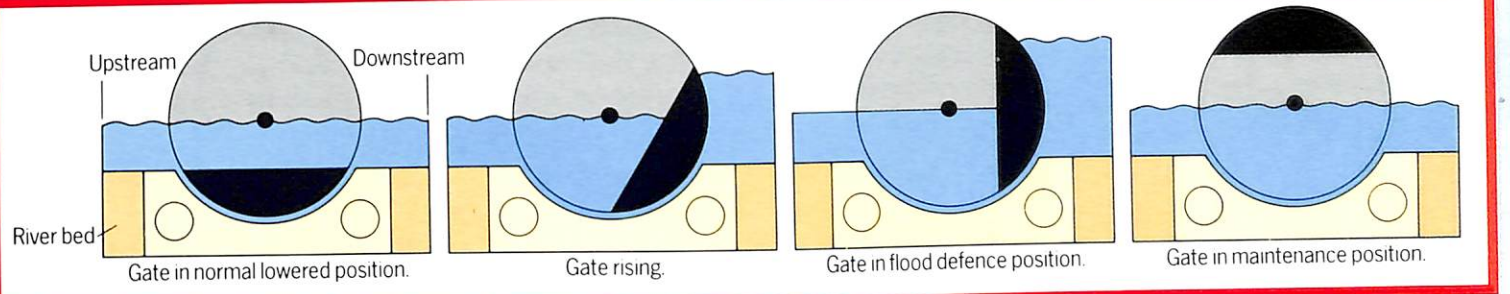
tunnels carrying power cables

ht of rising sector gate

concrete sill
weight largest weigh 10,000 tonnes

trunnion (pivotal) shaft

ned: 8 May 1984
olwich Reach, London
each gate: 20 metres
f each gate: 3,700 tonnes
ank to bank): 520 metres
tion time: Eight years
tion cost: £535 million
cost: £3.3 million per year



DEFENCE

LONDON - PROTECTED FROM THE FLOOD

PIVOTING GATES

When not in use, the gates rest in concrete sills on the river bed. If a high tidal surge threatens, the gates pivot through 90° to their vertical flood defence position: the rounded side faces downstream against the flood to form a continuous steel wall across the river. This process takes only 30 minutes. The gates are likely to be in position about four hours before the surge tide hits.